ARJUNA

JEE

LECTURE - 01

Atomic structure

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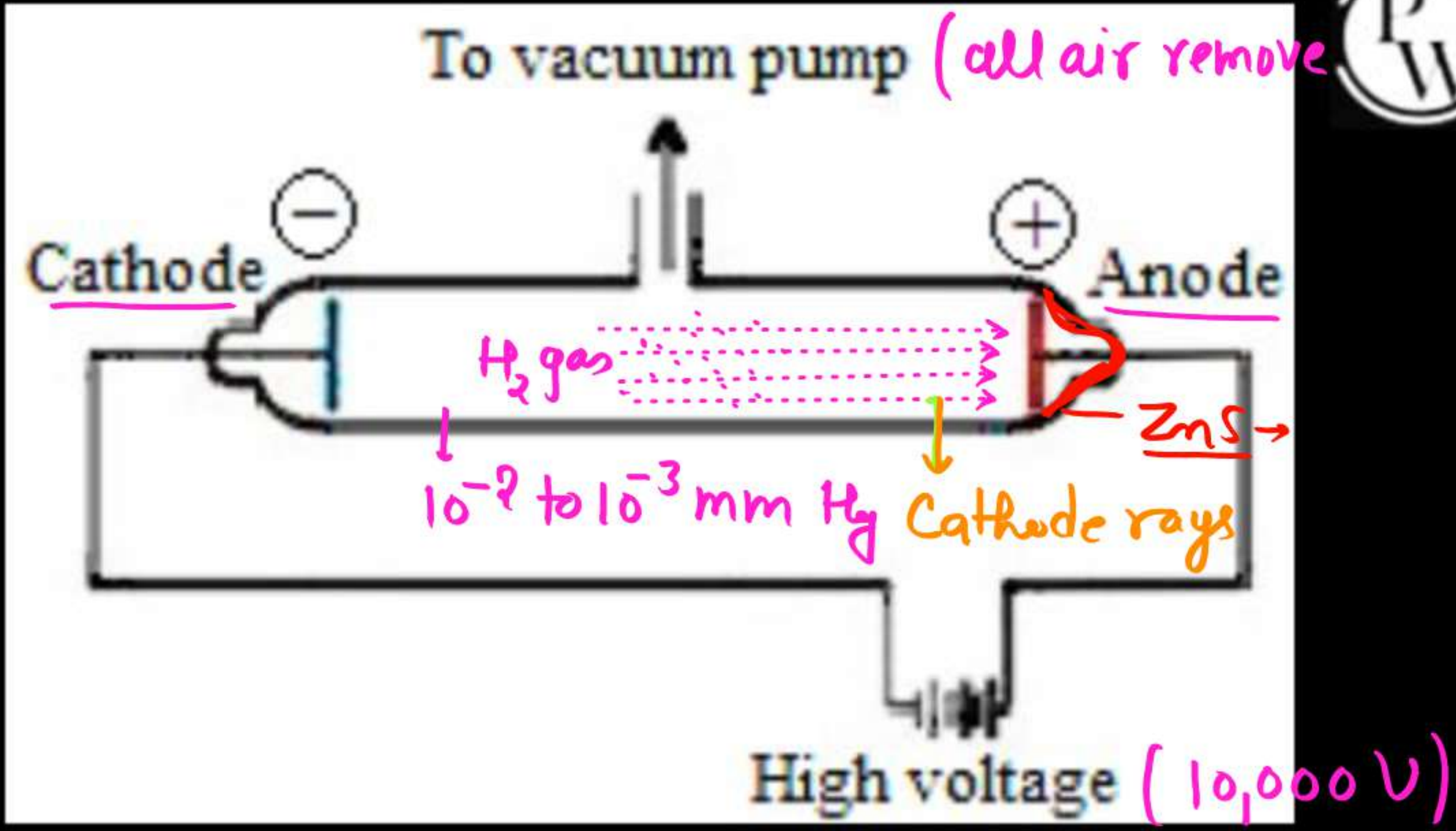
→ 10,000 V ⇒

H — H ⟶ 2H

H ⟶ H^+ + e^-
↓
electron

Opposite charge = Attraction



↓
battery

discharge tube
⇓
Reason = gas is ionise

Discovery of Electron

properties of cathode rays

(1) Straight line travell Krti hai

(2) direction → Cathode (−) ⟶ Anode (+)

(3) Cathode rays rotate metal wheel,

(4) Cathode rays have mass

→ Mass of e^- = 9.1×10^{-28} gram
or
9.1×10^{-31} kg

→ Charge of e^- = -1.6×10^{-19} Column

(Mulliken oil drop method)

→ photoelectric plate = effect Krthai
(White → Black krta hai)

→ Collection of negative charge particles (e^-) = Cathode rays

↓

Reason ⇒ because → come for cathode side (Cathode Ki ore se aa rahi hai)

$\frac{e}{m}$ ratio or $\frac{\text{Charge}}{\text{mass}}$ ratio or specific Charge ratio

---

$$\frac{e}{m} \text{ ratio} = \frac{\text{Charge of } e^-}{\text{Mass of } e^-} = \frac{1.6 \times 10^{-19}\, C}{9.1 \times 10^{-28}\, \text{gram}} \simeq 1.75 \times 10^{8}\, C/\text{gram}$$

or

$$1.75 \times 10^{11}\, C/\text{Kg}$$

→ $\frac{e}{m}$ ratio of $\bar{e}$ is Constant for all Gases. ($1.75 \times 10^{-11} \frac{C}{Kg}$)

→ electron is a fundamental particle of atom (each atom me ė jarur hoga)

→ value of $\frac{\bar{e}}{m}$ ratio does not depend upon nature of gas

→ value of $\frac{e}{m}$ ratio depend upon of Voltage of battery

Suppose → $\frac{e}{m}$ ratio → 10,000V = $x \frac{C}{Kg}$

$\frac{e}{m}$ ratio ⇒ 15,000V = $y \frac{C}{Kg}$

($x \neq y$)

Q $\frac{e}{m}$ ratio of e^- in Exp-1 ($V = 10{,}000\ V$) is $1.75 \times 10^{11} \frac{C}{kg}$

select the correct statements for $\frac{e}{m}$ ratio value of e^- in gas H_2, O_2, He

(a) $\frac{e}{m}$ ratio value max. for gas He

(b) $\frac{e}{m}$ ratio value max. for gas H_2

(c) $\frac{e}{m}$ ratio value max for gas O_2

✓ (d) $\frac{e}{m}$ ratio value is equal for H_2, O_2 & He gas

Q $\frac{e}{m}$ ratio of e^- in Exp-1 ($V = 10{,}000\,V$) is $1.75 \times 10^{-11} \frac{C}{kg}$

$\frac{e}{m}$ ratio of e^- at voltage $15000\,V$ is approx

(a) $\frac{e}{m}$ ratio $= 1.75 \times 10^{-11} \frac{C}{kg}$

✓(b) $\frac{e}{m}$ ratio $\neq 1.75 \times 10^{-11} \frac{C}{kg}$

$\frac{e}{m}$ ratio $= \frac{e}{m_v}$

m_v = moving mass of particle

$$m_v = \frac{m_{rest}}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$$

Where ⇒ m_{rest} = Rest mass of particle
v = Velocity of particle

C = Speed of light

$v < c$ → always

Velocity $\propto$ voltage
(v)

$m_v \propto \frac{1}{\text{voltage}}$

$\left(\frac{e}{m}\right) \propto$ voltage

$C_{SD} = 1$ → $\frac{e}{m}$ ratio of $e^- = 1.75 \times 10^{-11} \frac{C}{Kg}$

→ $\frac{e}{m}$ ratio of e^- → not depend upon nature of gas

→ depend upon voltage of battery

$\frac{e}{m}$ ratio $\propto$ voltage

→ $\frac{e}{m}$ ratio of Anode rays depend upon nature of gas and voltage of battery

$\Rightarrow \frac{e}{m}$ ratio $\propto$ voltage

Q $\frac{e}{m}$ ratio of e^- in two different Exp-1 ($V = 10{,}000\, eV$), & Exp-2 ($V = 15000\, eV$) are $x \frac{C}{kg}$ & $y \frac{C}{kg}$ respectively.

Select correct relation.

(a) $x = y$ ✗

(b) $x = 2y$ ✗

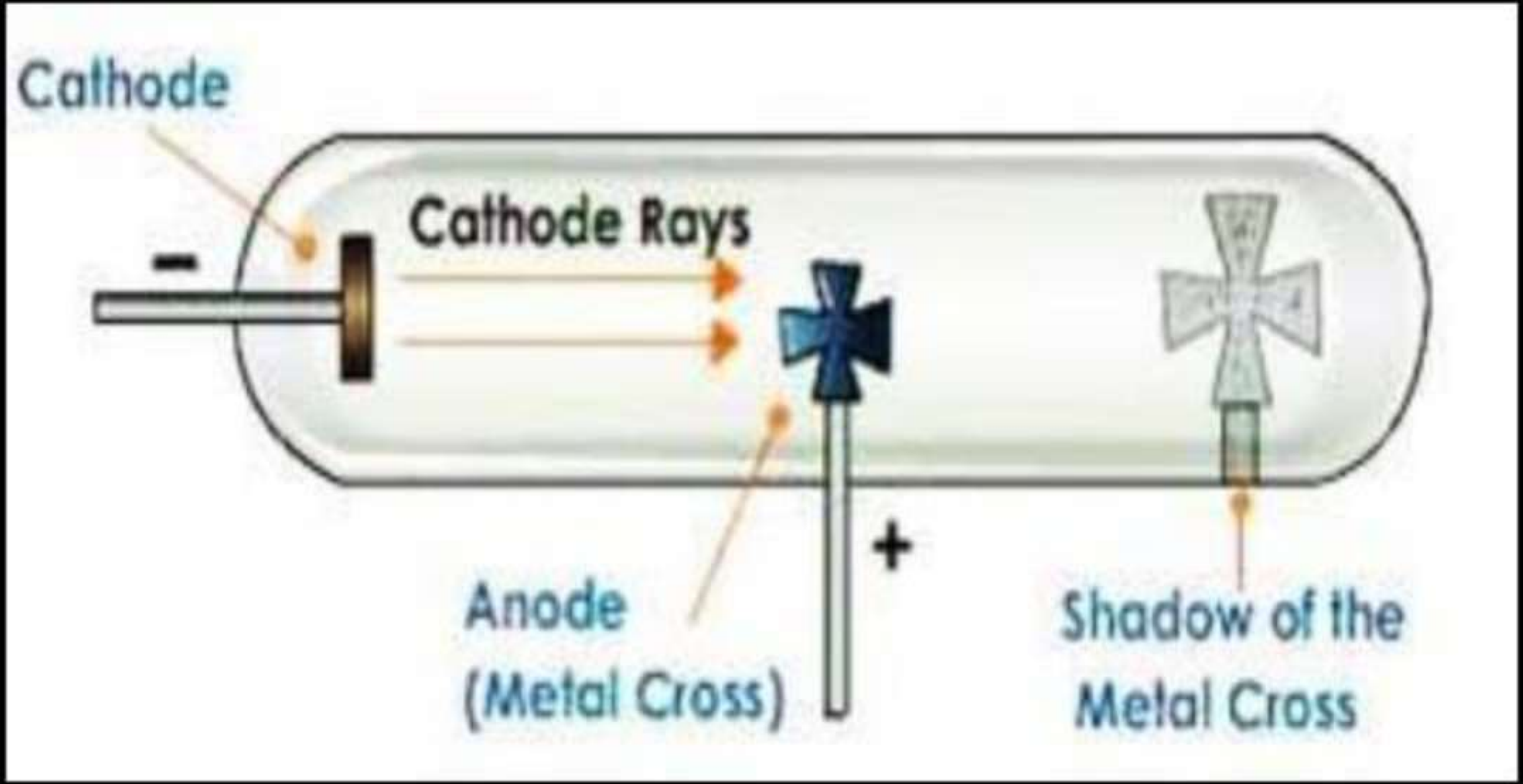
(c) $x > y$ ✗

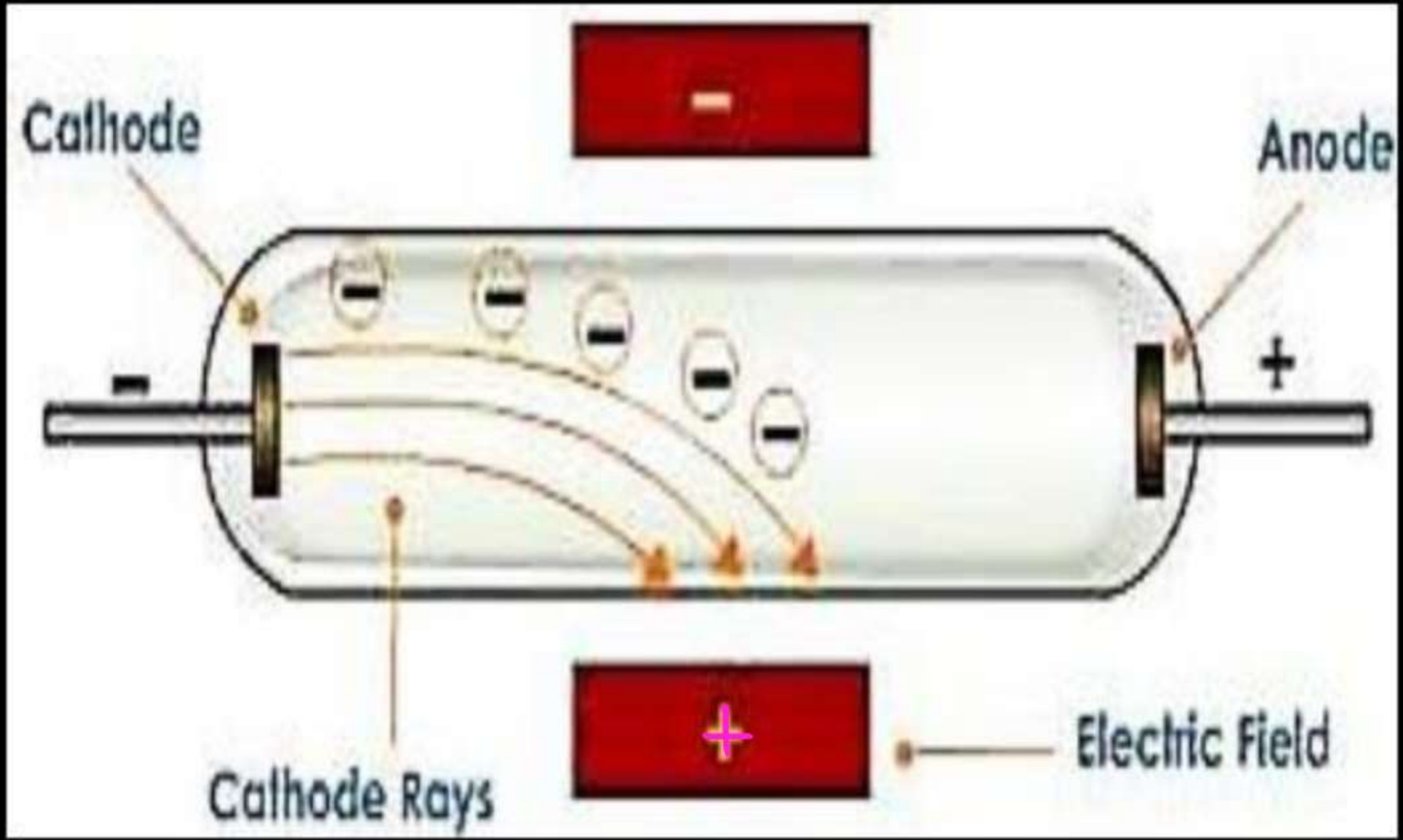
(d) $x < y$ ✓

Sol^n

$\frac{e}{m}$ ratio $\propto$ Voltage

$x < y$

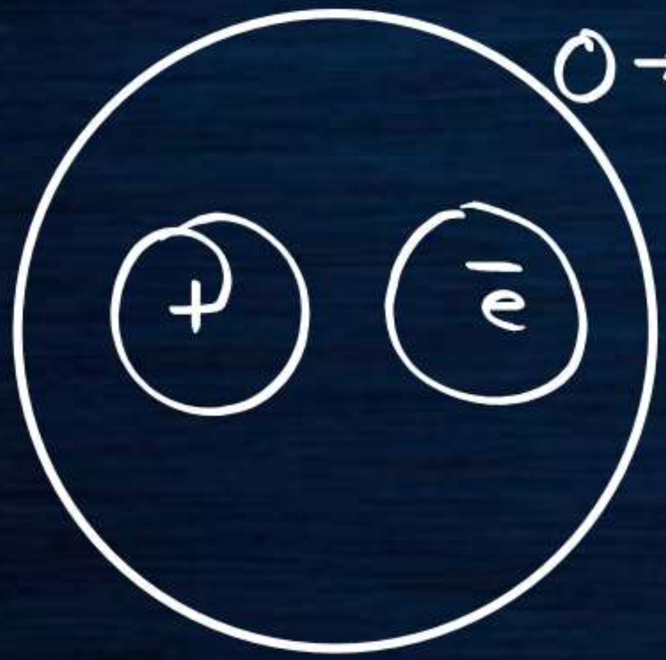

Cathode
Cathode Rays
−
+
Anode
(Metal Cross)
Shadow of the
Metal Cross



(negative charge Ka collection hai)
(electron)

Discovery of Proton

Atom → Neutral



0 → zero charge → Atom neutral

$H \not- H \longrightarrow 2H$

Atom

$H \longrightarrow H^+ + e^-$

+ve charge

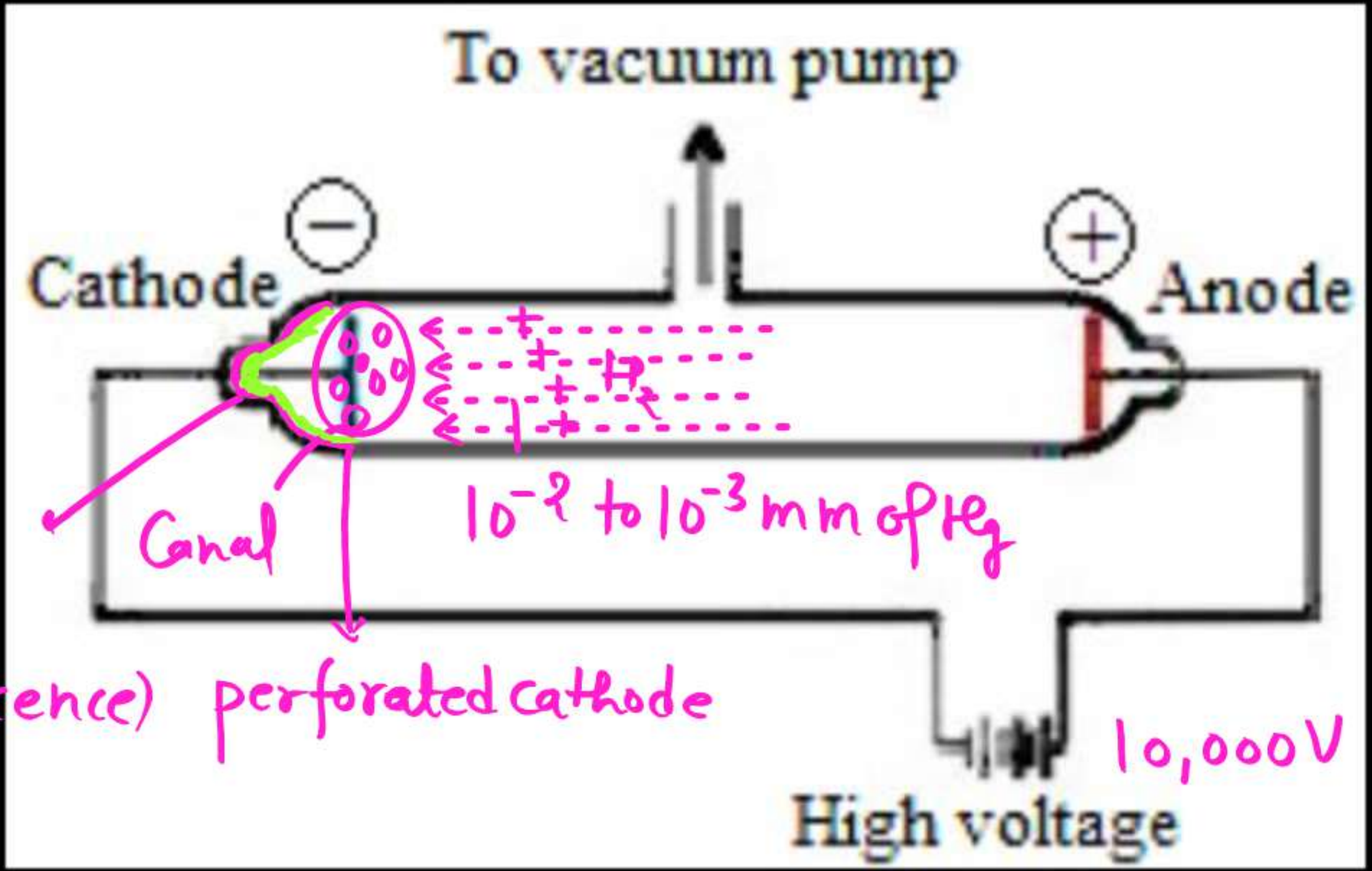
Ka collection (proton)

Canal rays or Anode rays (Reason = Anode to Cathode)

ZnS

(Flourscence)

glow



→ straight line travell

→ rotate the metal whell

→ Effect photoelectric plate

→ Mass of proton = 1.67×10^{-24} gram = 1.67×10^{-27} Kg

→ Charge of proton = $+1.6 \times 10^{-19}$ Column = 1.6×10^{-19} C

→ $\frac{e}{m}$ ratio of proton = $\frac{\text{Charge}}{\text{Mass}} = \frac{1.6 \times 10^{-19}}{1.67 \times 10^{-27}\text{ Kg}} = 9.5 \times 10^{7} \frac{C}{Kg}$

$\frac{e}{m}$ ratio of Canal rays or Anode rays depend upon **nature of gas**

Ex → $H_2 \longrightarrow H \not{-} H \longrightarrow 2H \longrightarrow$ H^+

↳ Collection of H^+ = Anode rays

Ex → $He \longrightarrow He \longrightarrow He \longrightarrow$ He^{+2}

↳ Collection of He^{+2} = Anode rays

Ex → $O_2 \longrightarrow O{=}O \longrightarrow 2O \longrightarrow$ O^+

↳ Collection of O^+ = Anode ray

→ proton is a also fundamental particle of atom

$\frac{e}{m}$ ratio of Anode rays also depend upon voltage of battery

Q select the correct statements for value of $\frac{e}{m}$ ratio of e^- and p^+, if Hydrogen (H_2) gas filled in discharge tube.

(a) $\left(\frac{e}{m}\text{ ratio}\right)_{e^-} = \left(\frac{e}{m}\text{ ratio}\right)_{p^+}$

(b) $\left(\frac{e}{m}\text{ ratio}\right)_{e^-} < \left(\frac{e}{m}\text{ ratio}\right)_{p^+}$

✓ (c) $\left(\frac{e}{m}\text{ ratio}\right)_{e^-} > \left(\frac{e}{m}\text{ ratio}\right)_{p^+}$

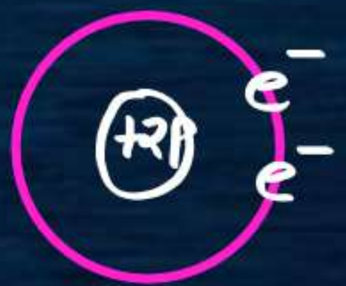
(d) None of these

		charge	mass
$\frac{e}{m}$ ratio $\rightarrow$	e^- =	-1.6×10^{-19},	9.1×10^{-31} kg
	p^+ =	$+1.6\times10^{-19}$,	1.67×10^{-27} kg

Discovery of Neutron

$(p^+)_{mass} + (e^-)_{mass} < (Atom)_{mass}$

He-atom $\rightarrow {}_2He^4$



$${}_2He^4 \longrightarrow ({}_2He^4)^{+2} + 2e^-$$

${}_2He^4$ ↓ He-atom; $({}_2He^4)^{+2}$ ↓ α-particle

He-atom $= {}_2He^4$

α-particle $= {}_2He^4$

Symbol of atom $\Rightarrow {}_ZX^A$

$Z =$ No. of proton

$A = P + n$

$$ {}_{4}Be^{9} + {}_{2}He^{4} \longrightarrow {}_{6}C^{12} + {}_{0}n^{1} $$

α-particle (under ${}_{2}He^{4}$)

└→ neutron (under ${}_{0}n^{1}$)

Mass of neutron = 1.67×10^{-24} gram = 1.67×10^{-27} kg

Charge of neutron = zero

properties	electron (e^-)	proton	neutron
1. symbol	e^-	p^+ or H^+	$_0n^1$
2. Charge (Absolute charge)	$-1.6 \times 10^{-19} C$	$+1.6 \times 10^{-19} C$	zero
3. Relative charge	-1	$+1$	zero
4. mass	$9.1 \times 10^{-31} kg$	$1.67 \times 10^{-27} kg$	$1.67 \times 10^{-27} kg$
5. Relative mass w.r.t. Mass of H-atom	$\frac{1}{1837} \times$ Mass of H-atom	1 (Mass of H-atom)	1 (Mass of H-atom)

Q Calculate of e^-, p^+ and n^0 in term of amu.

Sol^n = $1\ amu = 1.66 \times 10^{-24}\ gram = 1.66 \times 10^{-27}\ kg$

$$\text{Mass of } e^- = \frac{9.1 \times 10^{-31}}{1.66 \times 10^{-27}}\ amu$$

$$= 5.48 \times 10^{-4}\ amu$$

or

$$\text{Mass of } e^- = 0.000548\ amu$$

CSD = 2

$$\text{mass of particle in term of amu} = \frac{\text{Mass of particle}}{1.66 \times 10^{-27}\ kg}$$

$Na \longrightarrow Na^{+} + e^{-}$

$\underline{1.6 \times 10^{-19}}$

$H \longrightarrow H^{+} + e^{-} \longrightarrow 9.1 \times 10^{-31}\ Kg$

$\downarrow$

$proton = 1.67 \times 10^{-27}\ Kg$

$$\frac{proton}{electron} = \frac{1.67 \times 10^{-27}}{9. \times 10^{-31}} = \underline{1.8 \times 10^{3}}$$

$\underline{1800}$

$(proton)_m = 1800 \times (electron)_m$

Q The specific charge of the canal rays :

$\frac{e}{m}$ ratio Anode rays

A is not constant but changes with gas filled in discharge tube ✓

B Remains constant irrespective of the nature of gas in discharge tube

C is maximum when gas present in discharge tube is hydrogen ✓

D is 9.58×10^4 coulombs /g for H_2 gas

Q The increasing order (lowest first) for the values of e/m (charge/mass) for electron (e), proton (p), neutron (n) and alpha particle (α) is ___. [1984, 1 M]

2022-2021

A e, p, n, α

B n, p, e, α

C n, p, α, e

D n, α, p, e

$\alpha\ ({}_2He^4)^{+2}$

	e	p	n	α
e	1	1	0	2
m	$\frac{1}{1837}$	1	1	4
$\frac{e}{m}$	$\frac{1}{\frac{1}{1837}} = 1837$	$\frac{1}{1} = 1$	$\frac{0}{1} = 0$	$\frac{2}{4} = \frac{1}{2}$

Q For cathode rays' the value of e/m

A Is independent of the nature of the cathode and the gas filled in the discharge tube

(a, b, c)

B is constant

C is -1.7588×10^8 coulombs /g

D is lowest when hydrogen gas is filled in discharge tube

Q The study of cathode rays (i.e. electronic discharge through gases) shows

A Alpha particles are heavier than protons

B All forms of matter contain electrons

C All nuclei contain protons

D e/m is constant

Q Which has highest e/m ratio :

A $He^{2+} \rightarrow \frac{2}{4}$

B $H^{+} \rightarrow \frac{1}{1}$

C $He^{1+} \rightarrow \frac{1}{4}$

D $H \rightarrow \frac{0}{1}$

Q Proton is :

A Nucleus of deuterium α ${}_1H^2 = D \rightarrow D^+$

B Ionised hydrogen atom $H \rightarrow H^+$

C Ionised hydrogen molecule α $\rightarrow H_2 \rightarrow H_2^+$

D An α-particle α

Q Mass of neutron is ..... times the mass of electron

A 1840

B 1480

C 2000

D 1437

Mass of $e^- = \frac{1}{1837} \times$ mass of H-atom $\simeq \frac{1}{1837} \times$ mass of neutron

Mass of H-atom $\simeq$ Mass of neutron

Home work

No Home work

Thank - You